

a first set of resilient elongated electrical conductors, each having a first end electrically interconnected to a respective one of the contact locations of the first set of contact locations,

a second end distant from the substrate, and an elongated section extending from the first end to the second end, the elongated section resiliently bending upon depression of the second end towards the substrate, the second ends of the elongated electrical conductors are at an angle with respect to the first end of the elongated electrical conductor and the contact location, the angle being between a minimum and a maximum value, wherein the second ends of two adjacent resilient contact structures are spaced as determined by the angles corresponding to the first and second elongated electrical conductors and wherein respective ones of the second set of contact locations are coupled to corresponding ones of the first set of contact locations; and

a second set of elongated electrical conductors, each having a first end electrically interconnected to a respective one of the contact locations of the second set of contact locations, a second end distant from the substrate, and an elongate section extending from the first end to the second end.

~~251~~
~~252.~~ (Added) A structure, according to claim ~~250~~ 251, further comprising:

an enlargement at ends of the first plurality of resilient elongated electrical conductors.

~~252~~
~~253.~~ (Added) A structure, according to claim ~~250~~ 251, wherein:

the first plurality of resilient contact structures are composite electrical interconnection elements comprising a first enlargement at the first end, a second enlargement at the second end and an electrically conductive wire electrically interconnecting the first enlargement and the second enlargement.

~~253~~
254. (Added) A structure, according to claim ~~250~~ 251, wherein:

the first plurality of resilient elongated electrical conductors are fabricated on a sacrificial substrate prior to electrical interconnection of the first plurality of elongated electrical conductors to the first plurality of contact locations.

~~254~~
255. (Added) A structure, according to claim ~~250~~ 251, further comprising:

a subset of the second set of elongated electrical conductors directly electrically interconnected to the second set of contact locations.

~~255~~
256. (Added) A structure, according to claim ~~254~~ 255, wherein:

the second plurality of elongated electrical conductors are composite interconnection elements comprising:

a first enlargement at the first end

a second enlargement at the second end; and

an electrically conductive wire electrically interconnecting the first enlargement and the second enlargement.

~~256~~
257. (Added) A structure, according to claim ~~250~~ 251, wherein:

the second set of elongated electrical conductors are resilient.

~~257~~
258. (Added) A structure, according to claim ~~250~~ 251, wherein:

the second set of elongated electrical conductors are pins.

~~258~~
259. (Added) A structure, according to claim ~~251~~²⁵⁰, further including:

a dielectric material disposed on said first surface enveloping a part of said first set of resilient elongated electrical conductors.

~~259~~
260. (Added) A structure, according to claim ~~250~~²⁵⁸, wherein:

the second set of elongated electrical conductors are resilient and further including a dielectric material disposed on the second surface and enveloping a part of the second set of elongated electrical conductors.

~~260~~
261. (Added) A structure, according to claim ~~252~~²⁵¹, wherein:

the second plurality of resilient elongated electrical conductors are fabricated on a sacrificial substrate prior to electrically interconnecting the second plurality of resilient elongated electrical conductors to the second plurality of contact locations.

~~261~~
262. (Added) A Probe Assembly, comprising:

a second space transformer having a first surface, a second surface and a first plurality of contact locations on the first surface thereof;

an interconnection structure having a first surface, a second surface, a second plurality of electrical conductors extending from the second surface thereof and a first plurality of electrical conductors extending from the first surface thereof; and

a first space transformer having a first surface, a second surface, a plurality of contact locations disposed on the second surface thereof, and a third plurality of elongated resilient electrical conductors extending from the first surface thereof; wherein:

the second plurality of electrical conductors effect a pressure connection with the contact locations of the second space transformer; and

the first plurality of electrical conductors effect a pressure connection with the contact locations of the first space transformer.

~~202~~
~~263.~~ (Added) A Probe Assembly, according to claim ~~262~~, wherein:

the interconnection structure comprises a dielectric material comprising a plurality of elongated electrical conductors embedded therein;

a plurality of first ends of which comprise the first plurality of electrical conductors and a plurality of second ends of which comprise the second plurality of electrical conductors.

~~203~~
~~264.~~ (Added) A Probe Assembly, according to claim ~~262~~, wherein:

the second plurality of electrical conductors are pins.

~~204~~
~~265.~~ (Added) A structure, according to claim ~~262~~, further including:

a dielectric material disposed on said first surface of the interconnecting structure enveloping a part of said first set of resilient elongated electrical conductors.

~~205~~
~~266.~~ (Added) A Probe Assembly, according to claim ~~265~~, wherein:

the first set of electrical conductors are elongated and resilient and further including a dielectric material disposed on the first surface and enveloping a part of the first set of elongated electrical conductors.

~~206~~
~~267.~~ (Added) A Probe Assembly, according to claim ~~262~~, wherein:

the third plurality of elongated resilient electrical conductors are electrically interconnected to contact locations on the first surface of the first space transformer.

~~207~~
~~268.~~ (Added) A Probe Assembly, according to claim ~~261~~ 262, further including:

a dielectric material disposed on the first surface of the space transformer enveloping a part of the third plurality of elongated resilient electrical conductors.

~~268~~
~~269.~~ (Added) A Probe Assembly, according to claim ~~261~~ 262, wherein:

the first plurality of electrical conductors are composite elongated resilient electrical interconnection elements comprising:

a first enlargement at a first end thereof, a second enlargement at a second end thereof; and

a wire interconnecting the first enlargement and the second enlargement.

~~269~~
~~270.~~ (Added) A Probe Assembly, according to claim ~~261~~ 262, wherein:

the second plurality of electrical conductors are composite elongated resilient electrical interconnection elements comprising:

a first enlargement at a first end thereof, a second enlargement at a second end thereof; and

a wire interconnecting the first enlargement and the second enlargement.

~~270~~
~~271.~~ (Added) A Probe Assembly, according to claim ~~261~~ 262, wherein:

the third plurality of elongated resilient electrical conductors are composite electrical interconnection elements comprising:

a first enlargement at a first end thereof, a second enlargement at a second end thereof; and

a wire interconnecting the first enlargement and the second enlargement.

~~271~~
~~272.~~ (Added) A Probe Assembly, according to claim ~~261~~ 262, wherein:

one or more of the first plurality of electrical conductors are an elongated resilient composite structure comprising an elongated element and a coating.

~~272~~
~~273.~~ (Added) A Probe Assembly, according to claim ~~261~~ 262, wherein:

one or more of the second plurality of electrical conductors are an elongated resilient composite structure comprising an elongated element and a coating.

~~273~~
~~274.~~ (Added) A structure, according to claim ~~261~~ 262, further comprising:

a clamp for holding the first space transformer in place with respect to said second space transformer,

the clamp comprises a sheet of material supported by a member perpendicularly disposed with respect to the second space transformer;

means for affixing the sheet to the member; and

means for urging the first space transformer towards the first surface of the second space transformer.

~~274~~
275. (Added) A Probe Assembly, according to claim ~~273~~ 274, wherein said clamps comprises a sheet made of aluminum.

~~275~~
276. (Added) A Probe Assembly, according to claim ~~273~~ 274, wherein the means for urging the first space transformer comprises:

the sheet of material; and

a screw holding the sheet in place with respect to the member and the second space transformer with the first space transformer captured therebetween.

~~276~~
277. (Added) A Probe Assembly, according to claim ~~275~~ 276, wherein:

said sheet comprises aluminum.

~~277~~
278. (Added) A Probe Assembly, according to claim ~~275~~ 276, further comprising:

a member perpendicularly disposed with respect to the second space transformer for supporting the sheet of material.

~~278~~
279. (Added) A Probe Assembly, according to claim ~~275~~ 276, wherein the clamp comprises means for affixing a sheet of material supported by a member perpendicularly disposed with respect to the second space transformer, the sheet is held in place to the member by a screw forming the clamp to hold the first space transformer in place with respect to the second space transformer.

~~279~~
280. (Added) A Probe Assembly, according to claim ~~275~~ 276, wherein:

the sheet and the member are made of aluminum.

~~280~~
281. (Added) A Probe Assembly, according to ~~281~~ 262, further comprising:

means for aligning of the first space transformer relative to the second space transformer.

~~281~~
~~282.~~ (Added) A Probe Assembly, according to claim ~~280~~ 281, wherein the means for aligning the first space transformer comprises:

a plurality of pins disposed on the first space transformer.

~~282~~
~~283.~~ (Added) A Probe Assembly, according to claim ~~280~~ 281, wherein the means for aligning the first space transformer comprises:

a plurality of projections for mating with grooves on the interconnection structure.

~~283~~
~~284.~~ (Added) A Probe Assembly, according to claim ~~261~~ 262, wherein:

the contact locations are disposed at a first pitch on the second surface of the second space transformer;

the third plurality of elongated resilient electrical conductors are disposed at a second pitch on the first surface of the second space transformer.

~~284~~
~~285.~~ (Added) A Probe Assembly, according to claim ~~283~~ 284, wherein:

the first pitch is greater than the second pitch.

~~285~~
~~286.~~ ((Added) A Probe Assembly, according to claim ~~261~~ 262, wherein:

the first plurality of elongated resilient electrical conductors are disposed at a first pitch on the first surface of the interconnection structure;

the second plurality of elongated resilient electrical conductors are disposed at a second pitch on the second surface of the interconnection structure.

~~280~~
~~287.~~ (Added) A Probe Assembly, according to claim ~~261~~ 262, wherein:

the contact locations are disposed at a first pitch on the second surface of the first space transformer;

the third plurality of elongated resilient electrical conductors are disposed at a second pitch on the first surface of the second space transformer;

the first plurality of elongated resilient electrical conductors are disposed at the first pitch on the first surface of the interconnection structure;

the second plurality of elongated resilient electrical conductors are disposed at the first pitch on the second surface of the interconnection structure.

~~281~~
~~288.~~ (Added) A Probe Assembly, according to claim ~~286~~ 287, wherein the first pitch is greater than the second pitch.

~~288~~
~~289.~~ (Added) A Probe Assembly, according to claim ~~261~~ 262, wherein at least some of the elongated resilient electrical conductors comprise:

a composite interconnection element having an end; and

a protuberance disposed at the end of the composite interconnection element.

~~289~~
~~290.~~ (Added) A structure, according to claim ~~261~~ 262, wherein:

the third plurality of elongated resilient electrical conductors are electrically interconnected to contact locations on the first surface of the first space transformer.

²⁹⁰
~~291.~~ (Added) A structure, comprising:

a first space transformer having a first surface, a second surface, a plurality of contact locations disposed on the second surface thereof, and a plurality of elongated electrical conductors connected to the first surface thereof, said first space transformer adapted in use such that ends of the plurality of elongated electrical conductors for making pressure contacts with a corresponding plurality of contact locations on a semiconductor wafer; and

²⁹⁰
an interconnection structure having a first surface, a second surface, a first plurality of electrical conductors extending from the first surface thereof, said electrical interconnection structure adapted in use such that contact regions of the first plurality of electrical conductors make pressure connections with the plurality of contact locations on the second surface of the first space transformer, the electrical interconnection structure having a second plurality of electrical conductors extending from the second surface thereof, said interconnection structure adapted in use for contact locations of the second plurality of electrical conductors making pressure connections with a plurality of contact locations on a second space transformer.

²⁹¹
~~292.~~ (Added) A structure, according to claim ²⁹⁰~~291~~, wherein:

said interconnection structure comprises a dielectric material comprising a plurality of elongated electrical conductors embedded therein, a plurality of first ends of which comprise the first plurality of electrical conductors and a plurality of second ends of which comprise the second plurality of electrical conductors.

²⁹²
~~293.~~ (Added) A structure, according to claim ²⁹⁰~~291~~, wherein:

the contact locations are disposed at a first pitch on the second surface of the first space transformer;

the plurality of elongated electrical conductors are disposed at a second pitch on the first surface of the first space transformer.

²⁹³
~~294.~~ (Added) A structure, according to claim ²⁹²~~293~~, wherein said first pitch is greater than said second pitch.

²⁹⁴
~~295.~~ (Added) A structure, according to claim ²⁹⁰~~291~~, wherein:

the second plurality of elongated resilient electrical conductors are disposed at a first pitch on the second surface of the interconnection structure;

the first plurality of elongated resilient electrical conductors are disposed at a second pitch on the first surface of the interconnection structure.

²⁹⁵
~~296.~~ (Added) A structure according to claim ²⁹⁴~~295~~, wherein the first pitch is substantially the same as the second pitch.

²⁹⁰
~~297.~~ (Added) A structure, according to claim ²⁹⁰~~291~~, wherein:

the contact locations are disposed at a first pitch on the second surface of the space transformer;

the plurality of elongated resilient electrical conductors are disposed at a second pitch on the first surface of the space transformer;

the second plurality of elongated resilient electrical conductors are disposed at the first pitch on the second surface of the electrical interconnection structure;

the first plurality of elongated resilient electrical conductors are disposed at the first pitch on the first surface of the electrical interconnection structure.

~~297~~ 298. (Added) A structure according to claim ~~297~~²⁹⁶, wherein the first pitch is greater than the second pitch.

~~298~~ 299. (Added) A Probe Card Assembly, comprising:

a second space transformer having a first surface, a second surface and a plurality of second contact locations on the first surface thereof;

a first space transformer having a first surface, a second surface, a plurality of first contact locations disposed on the second surface thereof, and a first plurality of elongated resilient electrical conductors mounted adjacent to and extending from the first surface thereof;

wherein the plurality of first contact locations are connected to the plurality of second contact locations of the second space transformer.

~~299~~ 300. (Added) A Probe Card Assembly, according to claim ~~299~~²⁹⁸, wherein:

the first plurality of elongated resilient electrical conductors are mounted directly to contact locations on the first surface of the first space transformer.

~~300~~ 301. (Added) A Probe Card Assembly, according to claim ~~299~~²⁹⁸, wherein:

the first plurality of elongated resilient electrical conductors are connected to contact locations on the first surface of the first space transformer.

~~301~~ 302. (Added) A Probe Card Assembly, according to claim ~~299~~²⁹⁸, wherein:

the first plurality of elongated resilient electrical conductors are composite interconnection elements.

~~302~~ ~~303.~~ (Added) A Probe Card Assembly, according to claim ~~299~~²⁹⁸, further comprising:

means for aligning the first space transformer relative to the second space transformer.

~~303~~ ~~304.~~ (Added) A Probe Card Assembly, according to claim ~~303~~³⁰², wherein the means for aligning the first space transformer comprises:

a plurality of pins disposed on the first space transformer.

~~304~~ ~~305.~~ (Added) A Probe Card Assembly, according to claim ~~303~~³⁰², wherein the means for aligning the first space transformer comprises:

a plurality of engaging projections and grooves.

~~305~~ ~~306.~~ (Added) A Probe Card Assembly, according to claim ~~299~~²⁹⁸, wherein:

the contact locations are disposed at a first pitch on the second surface of the first space transformer;

the first plurality of elongated resilient electrical conductors each having a second end, the second ends of the elongated electrical conductors are at an angle with respect to the first end of the elongated electrical conductor and the contact location, the angle being between a minimum and a maximum value, the second ends are disposed at a second pitch as determined by the angles corresponding to the first plurality of elongated resilient electrical conductors; and

the first pitch is a shortest distance between any two adjacent contact pads and the second pitch is a shortest distance between any two adjacent elongate electrical conductors.

300

~~307.~~ (Added) A Probe Card Assembly, comprising:

a second space transformer having a first surface, a second surface and a plurality of second contact locations on the first surface thereof;

a first space transformer having a first surface, a second surface, a plurality of first contact locations disposed on the second surface thereof, and a first plurality of elongated electrical conductors electrically connected adjacent to and extending from the first surface thereof;

wherein the plurality of first contact locations are connected to the plurality of second contact locations of the second substrate.

307

~~308.~~ (Added) A Probe Card Assembly, according to claim ~~307~~³⁰⁰, wherein:

the first plurality of elongated electrical conductors are electrically interconnected to contact locations on the first surface of the first space transformer.

308

~~309.~~ (Added) A Probe Card Assembly, according to claim ~~307~~³⁰⁰, wherein:

the first plurality of elongated electrical conductors are electrically interconnected to contact locations on the first surface of the first space transformer.

309

~~310.~~ (Added) A Probe Card Assembly, according to claim ~~307~~³⁰⁰, wherein:

the first plurality of elongated electrical conductors are composite interconnection elements.

~~310~~
~~311.~~ (Added) A Probe Card Assembly, according to ~~307~~³¹⁰, further comprising:

means for aligning the first space transformer relative to the second space transformer.

~~311~~
~~312.~~ (Added) A Probe Card Assembly, according to claim ~~311~~³¹⁰, wherein the means for aligning the first space transformer comprises:

a plurality of pins disposed on the first space transformer.

~~312~~
~~313.~~ (Added) A Probe Card Assembly, according to claim ~~311~~³¹⁰, wherein the means for aligning the first space transformer comprises:

a plurality of engaging projections and grooves.

~~313~~
~~314.~~ (Added) A Probe Card Assembly, according to claim ~~307~~³¹⁰, wherein:

the contact locations are disposed at a first pitch on the second surface of the space transformer;

the first plurality of elongated electrical conductors each having a second end, the second end of the elongated electrical conductors are at an angle with respect to the first end of the elongated electrical conductor and the contact location, the angle being between a minimum and a maximum value, the second ends are disposed at a second pitch as determined by the angles corresponding to the first and second elongated electrical conductors; and

the first pitch is a shortest distance between any two adjacent contact pads and the second pitch is a shortest distance between any two adjacent elongated electrical conductors.

³¹⁴
~~315.~~ (Added) A Probe Assembly, according to claim ²⁸⁵~~286~~, wherein the first pitch is substantially the same as the second pitch.

³¹⁵
~~316.~~ (Added) A Probe Assembly, according to claim ²⁰²~~203~~, wherein:

the interconnection structure comprises a dielectric material comprising a plurality of elongated electrical conductors embedded therein:

a plurality of first ends of which comprise the first plurality of elongated resilient electrical conductors and a plurality of second ends of which comprise the second plurality of elongated resilient electrical conductors.

³¹⁶
~~317.~~ (Added) A structure, according to claim ²⁹¹~~292~~, wherein the plurality of first ends comprise a first plurality of elongated resilient electrical conductors and the plurality of second ends comprise a second plurality of elongated resilient electrical conductors.

³¹⁷
~~318.~~ (Added) A structure, according to claim ²⁶²~~263~~, wherein the plurality of first ends comprise a first plurality of elongated resilient electrical conductors and the plurality of second ends comprise a second plurality of elongated resilient electrical conductors.

REMARKS

Support for the added claims 251-318 is found throughout the specification and in US application serial number 07/685,368 filed on Oct. 19, 1992 incorporated by reference at page 7, lines 6-8 from the bottom, now issued as US 5,371,654 on December 6, 1994.

Claims 251-318 added herein are substantially identical to the claims of US 6,246,247 B1 which has an earliest claimed priority date of November 16, 1993. The present application is a continuation of US Application Serial Number 08/872,579, filed on